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ADDITIONAL STUDIES ON *PSEUDOMYRMEX APACHE* (HYMENOPTERA: FORMICIDAE)

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When *Pseudomyrmex apache* was described in this Journal in 1952 (1), the writer called attention to the fact that the incidence of this ant appeared to be greatest in the mountains of southeastern Arizona and that the incidence seemed to decrease sharply in areas south of that region. Additional field work in northern Mexico during the spring of 1953[1] has shown that this view is correct. Moreover, these studies indicate that the range of *apache* does not enter the tropics at all. This is a noteworthy distribution for a member of the genus *Pseudomyrmex*. The majority of the species in that genus are strictly confined to the Neotropical region and the few species which range into the southern United States are usually more abundant south of the Tropic of Cancer than north of it. The unique geographical position of *Ps. apache* is, therefore, a matter of unusual interest.

The new records for *apache* are presented below, together with a map showing the known range of this species:

TEXAS: Arsarca Canyon, Chinati Mts., (4800′) one colony *Quercus grisea.*

NUEVO LEON: China (600′) one colony in *Prosopis juliflora.*

[1]Field work done on a Guggenheim Fellowship.

CHIHUAHUA: 3 miles south of Encinillas (4900′) one colony in *Q. emoryi;* 16 miles west of General Trias (5800′) two colonies, one in *Q. emoryi,* the other in a deciduous oak (sp?); 23 miles south of Parral (5500′) one colony in *Q. santaclarensis;* 34 miles south of Parral (5800′) one colony in *Q. santaclarensis.*

DURANGO: Villa Ocampo (5700′) one colony in *Q. fusiformis* or closely related species.

It should be noted that, except for the two colonies taken

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west of General Trias, none of the stations in Chihuahua yielded more than a single colony. Many of the oak groves in Chihuahua, particularly those near the larger towns, have been denuded by wood-cutters. Despite this there are numerous areas where the groves are untouched. Those south of Parral are as extensive as any that the writer has encountered. Since *apache* will nest in at least three of the oaks present in this region, it follows that there are abundant nest sites available for it in central and southern Chihuahua. Yet the incidence of *apache* in these groves is low. In many groves the writer failed to find any specimens of *apache* and the few colonies which were secured are the result of repeated visits to the station at which they were finally taken. It may be recalled that identical collecting procedure in the oak groves of southeastern Arizona often produced from three to ten colonies per station.

The survey which gave the above records was carried south into Jalisco and Guanajuato and west through the Sierra Madre Occidental in Durango to the eastern border of Sinaloa. Except for the single record from Villa Ocampo, a small town five miles south of the Durango-Chihuahua border, no colonies of *apache* were taken south of the state of Chihuahua. The three southernmost records for *apache*, Villa Ocampo (Durango), China (Nueva Leon) and Monte Alto (Texas) are all near Latitude 26°. China lies about twenty-one miles to the south of the parallel, the other two stations lie a little to the north of it. Hence, there is a distance of at least one hundred and fifty miles between each of these stations and the Tropic of Cancer. The writer has repeatedly collected in the region between Latitude 26° and the Tropic of Cancer. The eighty-nine stations which have been visited extend from Tamaulipas through Nuevo Leon and southern Coahuila to the western border of Durango. Oaks were present at many of the stations and these oaks frequently contained arboreal ants. But the only record for *apache* coming from this region is the China record cited above. It is certain, therefore, that the incidence of *apache* south of Latitude 26° is even lower than it is in Chihuahua and it is probable that this ant is absent over much of the region between Latitude 26° and the tropics.

There are now enough records to show that *apache* occurs in a comparatively narrow band of territory, about twelve hundred miles long, which extends northwestward from the mouth of the Rio Grande River to southern California. Because of the skew of this band to the northwest it is difficult to give satisfactory northern and southern limits for the range of *apache*. If only latitude is considered the range runs from Lat. 33° 25′ to Lat. 25° 48′, a north-south extent of approximately 512 miles. But this method of delimiting the range is confusing, for it leaves out of account the fact that at any point along the east-west axis the width of the range is much less than five hundred miles. Indeed, in most places the band seems to be no more than two hundred miles wide and its maximum width does not exceed 370 miles. The distribution of *apache* throughout this long, narrow band is not uniform. The figures below show the total number of stations and colonies in each of the states where *apache* occurs.

	Stations	Colonies
California	1	2
Arizona	11	39
Chihuahua	5	10
Texas	3	4
Nuevo Leon	1	1
Durango	1	1

The very marked abundance of *apache* in the region near the southeastern border of Arizona is even more striking when it is considered that half of the ten colonies secured in Chihuahua came from a station in the extreme northwestern corner of the state (Nogales Ranch) which is only about thirty miles south of the U. S.-Mexico border. Since the most favorable part of the range of *apache* appears to be the region at the northern end of the Sierra Madre Occidental, it is instructive to consider the environmental conditions in this area.

The majority of the Arizona records for *apache* come from what Shreve (2) has called the "western xeric evergreen forest where oaks are dominant." This association is closely similar to LeSeur's (3) "*santaclarensis* consociation" in Chihuahua. There seems to be no essential climatic difference in the two biomes, the principal distinction be-

ing the dominant oak involved. In Arizona this is *Q. emoryi,* in Chihuahua it is *Q. santaclarensis.* Both these oak associations appear to reach their maximum development in areas where the average minimum annual temperature is not less than 15°F. or more than 20°F. In such areas light winter snows are not uncommon and minimum January temperatures as low as –6°F. have been recorded at several weather stations (4). The average annual rainfall in such areas is from 15 to 20 inches. Of this total more than half falls during the period from the first of July to the middle of September. Spring rains are exceptionally light, seldom comprising more than 10% of the total annual rainfall. Over most of the year there is a difference of at least 40°F. between the daily minimum and maximum temperatures. The humidity is low and the evaporation rate very high, since the area has an unusually large percentage of cloudless days.

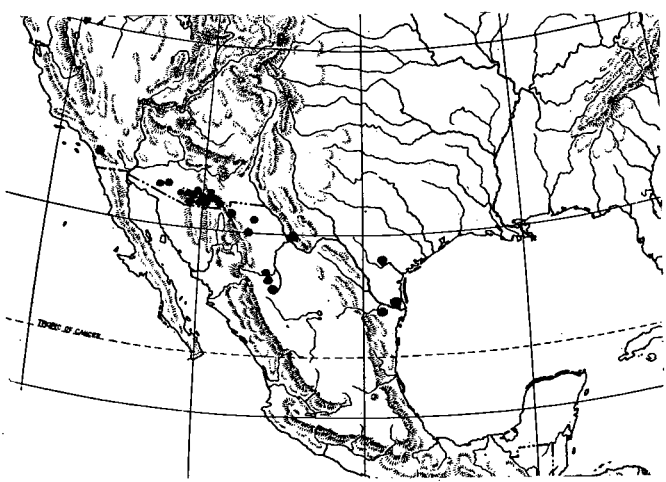

Fig. 1. Map showing the known distribution of *Pseudomyrmex apache* in the southwestern United States and northern Mexico.

It seems clear from the above data that *apache* can tolerate lower temperatures than most of the other species of *Pseudomyrmex* which occur in the southern United States.

For the range of *Ps. elongata* is confined to areas where the average annual minimum temperature is 30°F. or more (southern Florida). That of *Ps. gracilis mexicanum* is limited to areas where the above temperature is 25°F. or more (southern Texas). *Ps. brunnea* is restricted to areas where the average annual minimum temperature does not go below 20°F., hence, while it occurs as far north as the Carolinas and thence south through the Gulf States into Mexico, it does not occur in southern Arizona. Only *Ps. pallida,* whose tolerance for low temperatures is equal to that of *apache,* does so, and *pallida* occurs through the Gulf States and north to the Carolinas.

The question immediately arises as to why, since *apache* can tolerate low temperatures as well as *pallida,* does not *apache* occupy the same area as the latter species. The restricting factor in this case appears to be rainfall rather than temperature. Although *apache* can live in areas where the average annual rainfall is as low as ten inches, it has never been taken in an area where the annual average rainfall is more than twenty-four inches. Beginning in west Texas (10 inches) and running east to Alabama (65 inches) there is a gradient of rainfall which increases to the east. It is interesting to note that the line which marks the area where the average annual rainfall passes 25 inches lies only a few miles north and east of the known eastern limit of the range of *apache.* It is further interesting to note that there is a comparable gradient of rainfall which increases southward from the Rio Grande Valley down the coastal plain of Mexico. This gradient begins with 25 inches in the Brownsville area, rises to 45 inches at Tampico and reaches 64 inches at Vera Cruz. As has been noted elsewhere, *apache* appears to be absent in this area. This might be expected if the ant is unable to tolerate an average annual rainfall in excess of 24 inches.

If, as seems to be the case, it is rainfall rather than temperature which plays the major part in determining the range of *apache,* some interesting speculations can be advanced as to how *apache* reached its present geographical position. It may be taken as axiomatic that *apache* came to southern Arizona from tropical sources. Since three of the species of *Pseudomyrmex* which occur in the southern

United States also occur along the coastal plain of eastern Mexico, this region has served as a pathway for northern migration of some members of this genus. It is possible that *apache* might have come north by this route and reached southern Arizona by turning west up the Rio Grande Valley. But if this has been the case then the climatic conditions along the eastern coastal plain in Mexico must have been different from what they are now or *apache* must have acquired its low tolerance for annual rainfall *after* it turned west from the coastal plain. In either case it is difficult to see why *apache* should have stopped its migration along the coastal plain at the Rio Grande River. For, on either count, areas north of the Rio Grande along the Gulf Coast should have been available to it. It can be argued that subsequent climatic change eliminated *apache* from the Gulf Coast except for the narrow strip of arid territory in the Rio Grande Valley area. The writer finds it difficult to believe that there would not be some traces of *apache* left in other parts of the Gulf Coast region under such circumstances. A much more acceptable explanation of the present range of *apache* can be made if it is assumed that the insect migrated north along the Mexican Plateau. The traces of this northern progress are present along the western edge of the Plateau, for the decreasing incidence of *apache* south through Chihuahua may be regarded in this light. There is additional evidence from the responses of *apache* that it has had a long and extensive acquaintance with conditions on the Plateau. It has been shown elsewhere (1) that *apache* customarily nests in sizeable limbs or the trunk of the tree, and that it rarely, if ever, nests in hollow twigs as do many species of *Pseudomyrmex*. It has also been shown (5) that larger limbs, particularly those stubs which point upward, accumulate much moisture after a rain fall. It seems clear that *apache* has lived under arid conditions long enough to have restricted its nesting habits to the parts of the tree which provide the maximum conservation of moisture. Coupled with this is the large tolerance of *apache* for various sorts of trees as nest sites. To date this ant has been taken from six species of evergreen oak, two species of deciduous oak and mesquite. It is interesting to note that

there is a succession of different species of oaks from north to south along the Plateau and that these oaks by no means form a continuous belt throughout this region. There are many areas where the oaks are replaced by mesquite. It may be no more than a coincidence that *apache* accepts several species of oaks as well as mesquite as nest sites but, at least, this behavior is precisely what would be expected if *apache* had migrated north along the Mexican Plateau.

LITERATURE CITED

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